

negative pressure generating device that controls at least one of the variable valve train and the throttle valve to generate an intake

pipe negative pressure when a predetermined condition is satisfied.

4. The internal combustion engine according to claim 3, wherein the negative pressure generating device controls the variable valve train so as to increase pump efficiency of the internal combustion engine and also closes the throttle valve by a predetermined amount, when a negative pressure for operation of the negative pressure mechanism is insufficient.

5. The internal combustion engine according to claim 4, wherein the negative pressure generating device controls the variable valve train so as to increase pump efficiency of the internal combustion engine and also closes the throttle valve by a predetermined amount, when a vehicle provided with the internal combustion engine is running in a deceleration state.

6. The internal combustion engine according to claim 3, wherein the negative pressure generating device controls the variable valve train and the throttle valve so as not to generate torque variation of the internal combustion engine, when the intake pipe negative pressure is to be generated.

7. The internal combustion engine according to claim 3, wherein the negative pressure generating device controls the variable valve train and the throttle valve such that required torque for the internal combustion engine matches actual torque thereof, when the intake pipe negative pressure is to be generated.

16 8. The internal combustion engine according to claim 7, wherein the
 0 required torque is determined by using a number of revolutions of the
 internal combustion engine and an accelerator opening amount as
 parameters.

946
A3 9. The internal combustion engine according to claim 3, wherein the
 variable valve train drives the intake valve and/or the exhaust valve
 to open and close using electromagnetic force.

10. An internal combustion engine comprising:

a variable valve train capable of adjusting an opening and
 closing timing and/or opening amount of at least one of an intake valve
 and an exhaust valve of the internal combustion engine;

a negative pressure mechanism that operates using an intake pipe
 negative pressure generated in an intake passage of the internal
 combustion engine;

a throttle valve for adjusting a flow rate of intake air flowing
 through the intake passage; and

throttle valve controller that closes the throttle valve by a
 predetermined amount when a predetermined condition is satisfied.

940
A4 11. The internal combustion engine according to claim 10, further
 comprising valve train controller that, in a case where the throttle valve
 control means closes the throttle valve by the predetermined amount,
 controls the variable valve train so as to alter the opening and closing
 timing and/or opening amount of at least one of the intake valve and the

af exhaust valve with respect to a case where the throttle valve controller does not close the throttle valve by the predetermined amount.

12. The internal combustion engine according to claim 11, wherein the valve train controller controls the variable valve train such that required torque for the internal combustion engine matches actual torque thereof, when the throttle valve controller closes the throttle valve by the predetermined amount.

13. The internal combustion engine according to claim 12, wherein the required torque is determined by using a number of revolutions of the internal combustion engine and an accelerator opening amount as parameters.

14. The internal combustion engine according to claim 11, wherein the valve train controller controls the variable valve train so as to suppress torque variation of the internal combustion engine, when the throttle valve controller closes the throttle valve by the predetermined amount.

15. The internal combustion engine according to claim 10, further comprising intake air amount controller that controls the variable valve train to adjust an intake air amount of the internal combustion engine while retaining the throttle valve at a predetermined opening amount, when the internal combustion engine is in a predetermined operating state, wherein the throttle valve controller closes the throttle valve by the predetermined amount when the predetermined condition is satisfied while the intake air amount controller is controlling the intake air amount

through the intake passage;

throttle valve controller that closes the throttle valve by a predetermined amount when a predetermined condition is satisfied; and

valve train controller that, in a case where the throttle valve control means closes the throttle valve by the predetermined amount, controls the variable valve train so as to alter the opening and closing timing and/or opening amount of at least one of the intake valve and the exhaust valve with respect to a case where the throttle valve controller does not close the throttle valve by the predetermined amount.

20. The internal combustion engine according to claim 19, wherein the valve train controller controls the variable valve train such that required torque for the internal combustion engine matches actual torque thereof, when the throttle valve controller closes the throttle valve by the predetermined amount.

21. The internal combustion engine according to claim 20, wherein the required torque is determined by using a number of revolutions of the internal combustion engine and an accelerator opening amount as parameters.

22. The internal combustion engine according to claim 19, wherein the valve train controller controls the variable valve train so as to suppress torque variation of the internal combustion engine, when the throttle valve controller closes the throttle valve by the predetermined amount.

23. The internal combustion engine according to claim 19, wherein the

of the internal combustion engine.

16. The internal combustion engine according to claim 15, further comprising valve train controller that controls the variable valve train such that the intake air amount of the internal combustion engine does not change when the throttle valve controller closes the throttle valve by the predetermined amount.

17. The internal combustion engine according to claim 10, wherein the negative pressure mechanism is an evaporation fuel reflux mechanism for refluxing evaporation fuel generated in a fuel tank into the intake passage, and the throttle valve controller closes the throttle valve by the predetermined amount when the evaporation fuel reflux mechanism needs to be operated.

18. The internal combustion engine according to claim 10, wherein the variable valve train drives the intake valve and/or the exhaust valve to open and close using electromagnetic force.

19. An internal combustion engine comprising:

a variable valve train capable of adjusting an opening and closing timing and/or opening amount of at least one of an intake valve and an exhaust valve of the internal combustion engine;

a negative pressure mechanism that operates using an intake pipe negative pressure generated in an intake passage of the internal combustion engine;

a throttle valve for adjusting a flow rate of intake air flowing

variable valve train drives the intake valve and/or the exhaust valve to open and close using electromagnetic force.

24. An internal combustion engine comprising:

a variable valve train capable of adjusting an opening and closing timing and/or opening amount of at least one of an intake valve and an exhaust valve of the internal combustion engine;

a negative pressure mechanism that operates using an intake pipe negative pressure generated in an intake passage of the internal combustion engine;

a throttle valve for adjusting a flow rate of intake air flowing through the intake passage;

intake air amount controller that controls the variable valve train to adjust an intake air amount of the internal combustion engine while retaining the throttle valve at a predetermined opening amount, when an operating state of the internal combustion engine is in a predetermined operating region; and

throttle valve controller that closes the throttle valve by a predetermined amount from the predetermined opening amount when a predetermined condition is satisfied while the intake air amount controller is controlling the intake air amount of the internal combustion engine.

25. The internal combustion engine according to claim 24, wherein the variable valve train drives the intake valve and/or the exhaust valve to open and close using electromagnetic force.

26. An internal combustion engine comprising:

a variable valve train capable of adjusting an opening and closing timing and/or opening amount of at least one of an intake valve and an exhaust valve of an internal combustion engine;

a negative pressure mechanism that operates using an intake pipe negative pressure generated in an intake passage of the internal combustion engine;

a throttle valve for adjusting a flow rate of intake air flowing through the intake passage;

intake air amount controller that controls the variable valve train to adjust an intake air amount of the internal combustion engine while retaining the throttle valve at a predetermined opening amount, when an operating state of the internal combustion engine is in a predetermined operating region;

an evaporation fuel reflux mechanism for refluxing evaporation fuel generated in a fuel tank of the internal combustion engine into the intake passage; and

throttle valve controller that closes the throttle valve by a predetermined amount from the predetermined opening amount when the evaporation fuel reflux mechanism needs to be operated while the intake air amount controller is controlling the intake air amount of the internal combustion engine.

27. The internal combustion engine according to claim 26, wherein the variable valve train drives the intake valve and/or the exhaust valve to open and close using electromagnetic force.